

WHAT IS CLAIMED IS:

5

1. An optical scanning module comprising:
a light-emission source emitting a light

beam;

a movable mirror reflecting the light beam;

10 and

a movable mirror driving part that causes
said movable mirror to oscillate in first and second
opposite directions,

wherein a frequency of pixel information
15 supplied to said light-emission source varies in
accordance with a primary scanning position of each
of pixels.

20

2. The optical scanning module as claimed
in claim 1, further comprising a detection part that
detects a displacement of said movable mirror,

25 wherein a frequency modulation section is

10084487.022802

set to start after a given period of time passes
since a detection signal is obtained from said
detection part; and

5 a frequency causing said light-emission
source to emit light is varied within the frequency
modulation section.

10

3. The optical scanning module as claimed
in claim 2, wherein a start timing of the frequency
modulation section is varied based on the detection
signal obtained from said detection part.

15

4. The optical scanning module as claimed
20 in claim 2, wherein said movable mirror driving part
varies an amplitude of said movable mirror so that a
predetermined detection signal value may be obtained
in said detection part.

25

10084485.022802

5. The optical scanning module as claimed
in claim 4, wherein said movable mirror driving part
gradually increases the amplitude of said movable
mirror until the predetermined detection signal value
5 is obtained in said detection part in starting said
movable mirror.

10

6. The optical scanning module as claimed
in claim 4, wherein said light-emission source
inhibits image writing before the predetermined
detection signal value is obtained in said detection
15 part in starting said movable mirror.

20

7. The optical scanning module as claimed
in claim 4, wherein said movable mirror driving part
stops driving said movable mirror if the
predetermined detection signal value is prevented
from being obtained in said detection part within a
25 given time limit.

10084485.022802

8. The optical scanning module as claimed in claim 1, further comprising:

a detection part that detects a displacement of said movable mirror; and

5 a variable output setting part that sets a frequency variation section so that the frequency variation section starts after a given period of time passes since a detection signal is obtained from said detection part, and varies a light-emission output of
10 said light-emission source in accordance with the primary scanning position.

15

9. The optical scanning module as claimed in claim 1, wherein said movable mirror driving part reduces or stops a rotational oscillation force provided to said movable mirror at least in a period
20 other than an image writing period.

25

10. The optical scanning module as claimed

10084485.022602

in claim 9, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said
5 movable mirror.

10 11. The optical scanning module as claimed in claim 9, wherein said light-emission source inhibits image writing before the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

15

12. The optical scanning module as claimed
20 in claim 9, wherein said movable mirror driving part stops driving said movable mirror if the predetermined detection signal value is prevented from being obtained in said detection part within a given time limit.

25

10084485.022802

13. An optical scanning module comprising:
a light-emission source emitting a light
beam;
a movable mirror reflecting the light beam;
5 and
a movable mirror driving part that causes
said movable mirror to oscillate in first and second
opposite directions,
wherein a frequency causing said light-
10 emission source to emit light based on pixel
information varies in accordance with a primary
scanning position.
- 15
14. The optical scanning module as claimed
in claim 13, further comprising a detection part that
detects a displacement of said movable mirror,
20 wherein a frequency modulation section is
set to start after a given period of time passes
since a detection signal is obtained from said
detection part; and
the frequency causing said light-emission
25 source to emit light is varied within the frequency

10084485.022802

modulation section.

5

15. The optical scanning module as claimed
in claim 14, wherein a start timing of the frequency
modulation section is varied based on the detection
signal obtained from said detection part.

10

16. The optical scanning module as claimed
15 in claim 14, wherein said movable mirror driving part
varies an amplitude of said movable mirror so that a
predetermined detection signal value may be obtained
in said detection part.

20

17. The optical scanning module as claimed
in claim 16, wherein said movable mirror driving part
25 gradually increases the amplitude of said movable

10084485.022802

mirror until the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

5

18. The optical scanning module as claimed in claim 16, wherein said light-emission source
10 inhibits image writing before the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

15

19. The optical scanning module as claimed in claim 16, wherein said movable mirror driving part stops driving said movable mirror if the
20 predetermined detection signal value is prevented from being obtained in said detection part within a given time limit.

25

10034485.022802

20. The optical scanning module as claimed in claim 13, further comprising:

a detection part that detects a displacement of said movable mirror; and

5 a variable output setting part that sets a frequency variation section so that the frequency variation section starts after a given period of time passes since a detection signal is obtained from said detection part, and varies a light-emission output of
10 said light-emission source in accordance with the primary scanning position.

15

21. The optical scanning module as claimed in claim 13, wherein said movable mirror driving part reduces or stops a rotational oscillation force provided to said movable mirror at least in a period
20 other than an image writing period.

25

22. The optical scanning module as claimed

10084485.022802

in claim 21, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said
5 movable mirror.

10 23. The optical scanning module as claimed in claim 21, wherein said light-emission source inhibits image writing before the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

15

24. The optical scanning module as claimed
20 in claim 21, wherein said movable mirror driving part stops driving said movable mirror if the predetermined detection signal value is prevented from being obtained in said detection part within a given time limit.

25

10084485.022802

25. An optical scanning module comprising:
a light-emission source emitting a light
beam;

a movable mirror reflecting the light beam;
5 a movable mirror driving part that causes
said movable mirror to oscillate in first and second
opposite directions; and

a variable frequency setting part varying,
in accordance with an amplitude of said movable
10 mirror, a frequency causing said light-emission
source to emit light based on pixel information.

15 26. The optical scanning module as claimed
in claim 25, further comprising a detection part that
detects a displacement of said movable mirror,

wherein a frequency modulation section is
20 set to start after a given period of time passes
since a detection signal is obtained from said
detection part; and

the frequency causing said light-emission
source to emit light is varied within the frequency
25 modulation section.

10084485.022802

27. The optical scanning module as claimed in claim 26, wherein a start timing of the frequency modulation section is varied based on the detection signal obtained from said detection part.

5

28. The optical scanning module as claimed in claim 26, wherein said movable mirror driving part varies the amplitude of said movable mirror so that a predetermined detection signal value may be obtained in said detection part.

15

29. The optical scanning module as claimed in claim 28, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

25

10084485.022802

30. The optical scanning module as claimed
in claim 28, wherein said light-emission source
inhibits image writing before the predetermined
detection signal value is obtained in said detection
5 part in starting said movable mirror.

10 31. The optical scanning module as claimed
in claim 28, wherein said movable mirror driving part
stops driving said movable mirror if the
predetermined detection signal value is prevented
from being obtained in said detection part within a
15 given time limit.

20 32. The optical scanning module as claimed
in claim 25, further comprising:
a detection part that detects a displacement
of said movable mirror; and
a variable output setting part that sets a
25 frequency variation section so that the frequency

10084485-022802

variation section starts after a given period of time passes since a detection signal is obtained from said detection part, and varies a light-emission output of said light-emission source in accordance with a
5 primary scanning position.

10 33. The optical scanning module as claimed in claim 25, wherein said movable mirror driving part reduces or stops a rotational oscillation force provided to said movable mirror at least in a period
15 other than an image writing period.

20 34. The optical scanning module as claimed in claim 33, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said
25 movable mirror.

10084485.022802

35. The optical scanning module as claimed
in claim 33, wherein said light-emission source
inhibits image writing before the predetermined
detection signal value is obtained in said detection
5 part in starting said movable mirror.

10 36. The optical scanning module as claimed
in claim 33, wherein said movable mirror driving part
stops driving said movable mirror if the
predetermined detection signal value is prevented
from being obtained in said detection part within a
15 given time limit.

20 37. An optical scanning module comprising:
a light-emission source emitting a light
beam;
a movable mirror reflecting the light beam;
and
25 a movable mirror driving part that causes

10084485.022802

said movable mirror to oscillate in first and second opposite directions,

wherein a light emission period forming one pixel on a scanned surface is varied with respect to a primary scanning direction to be minimized in a vicinity of a center of an image so that a light-emission interval between each of pixels forming pixel information is minimized in the vicinity of the center of the image.

10

38. The optical scanning module as claimed in claim 37, further comprising a detection part that detects a displacement of said movable mirror,

wherein a frequency modulation section is set to start after a given period of time passes since a detection signal is obtained from said detection part; and

20

a frequency causing said light-emission source to emit light is varied within the frequency modulation section.

25

10084485.022602

39. The optical scanning module as claimed in claim 38, wherein a start timing of the frequency modulation section is varied based on the detection signal obtained from said detection part.

5

40. The optical scanning module as claimed in claim 1, wherein said movable mirror driving part varies an amplitude of said movable mirror so that a predetermined detection signal value may be obtained in said detection part.

15

41. The optical scanning module as claimed in claim 40, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said movable mirror.

25

10084485.022802

42. The optical scanning module as claimed
in claim 40, wherein said light-emission source
inhibits image writing before the predetermined
detection signal value is obtained in said detection
5 part in starting said movable mirror.

10 43. The optical scanning module as claimed
in claim 40, wherein said movable mirror driving part
stops driving said movable mirror if the
predetermined detection signal value is prevented
from being obtained in said detection part within a
15 given time limit.

20 44. The optical scanning module as claimed
in claim 37, further comprising:
a detection part that detects a displacement
of said movable mirror; and
a variable output setting part that sets a
25 frequency variation section so that the frequency

208220.58448007

variation section starts after a given period of time passes since a detection signal is obtained from said detection part, and varies a light-emission output of said light-emission source in accordance with a
5 primary scanning position.

10 45. The optical scanning module as claimed in claim 37, wherein said movable mirror driving part reduces or stops a rotational oscillation force provided to said movable mirror at least in a period
15 other than an image writing period.

20 46. The optical scanning module as claimed in claim 45, wherein said movable mirror driving part gradually increases the amplitude of said movable mirror until the predetermined detection signal value is obtained in said detection part in starting said
25 movable mirror.

10084485.022802

47. The optical scanning module as claimed
in claim 45, wherein said light-emission source
inhibits image writing before the predetermined
detection signal value is obtained in said detection
5 part in starting said movable mirror.

10 48. The optical scanning module as claimed
in claim 45, wherein said movable mirror driving part
stops driving said movable mirror if the
predetermined detection signal value is prevented
from being obtained in said detection part within a
15 given time limit.

20 49. An optical scanning device comprising:
a plurality of optical scanning modules
arranged so that primary scanning directions thereof
coincide with each other,
the optical scanning modules each
25 comprising:

10084485.022802

a light-emission source emitting a
light beam;

a movable mirror reflecting the light
beam; and

5 a movable mirror driving part that
causes said movable mirror to oscillate in first and
second opposite directions,

wherein a frequency of pixel information
supplied to said light-emission source varies in
10 accordance with a primary scanning position of each
of pixels.

15 50. The optical scanning device as claimed
in claim 49, wherein said light-emission source is
modulated in accordance with image data;

said movable mirror is supported by torsion
20 bars provided to a support substrate so as to be
oscillatable about the torsion bars as a rotary
shaft; and

said movable mirror driving part causes said
movable mirror to oscillate by periodically
25 generating attraction or a repulsive force between

10084485-022802

said support substrate and said movable mirror by switching voltages applied to said movable mirror driving part, said movable mirror driving part being provided on both of end parts of said movable mirror, 5 the end parts being positioned on opposite sides of each of the torsion bars.

10

51. The optical scanning device as claimed in claim 50, wherein the light beam emitted from said light-emission source of each of said optical scanning modules is caused to scan a region in the 15 primary scanning direction by said movable mirror so that image recording is performed by connecting the regions scanned by the light beams of said optical scanning modules.

20

52. The optical scanning device as claimed in claim 51, further comprising a variable pixel 25 frequency setting part that varies the pixel

10084485-022802

frequency modulating said light-emission source in accordance with an amount of oscillation of said movable mirror.

5

53. The optical scanning device as claimed in claim 52, further comprising beam detection parts each detecting a position of the light beam deflected by said movable mirror, the beam detection parts being provided outside the scanned region at positions corresponding to scanning starting and termination ends of each of the optical scanning modules, respectively,

wherein said variable pixel frequency setting part varies the pixel frequency based on a scanning period between detections of the light beam by the beam detection parts.

20

54. The optical scanning device as claimed in claim 52, wherein said variable pixel frequency

25

10084485.022802

setting part varies the pixel frequency in a plurality of steps during one scan.

5

55. The optical scanning device as claimed in claim 52, further comprising a variable driving current setting part that varies, in accordance with
10 the pixel frequency, a driving current supplied to said light-emission source so as to vary an amount of light emitted therefrom.

15

56. The optical scanning device as claimed in claim 51, further comprising a beam detection part detecting a position of the light beam deflected by
20 said movable mirror, the beam detection part being provided outside the scanned region at a position corresponding to a scanning starting end of each of the optical scanning modules,

wherein, a reference signal for starting
25 image writing is switched between detection signals

10084485.022802

output from the beam detection part based on timing of application of the driving voltages to said movable mirror driving part.

5

57. The optical scanning device as claimed in claim 51, further comprising a beam detection part
10 detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region of each of the optical scanning modules,

wherein the light beam is turned within a
15 region detectable by said beam detection part so as to perform scanning in the first and second opposite directions.

20

58. The optical scanning device as claimed in claim 51, wherein the optical scanning modules are arranged so that the scanned regions of each adjacent
25 two of the optical scanning modules are apart from

10084485.022802

each other by one scanning pitch in a secondary scanning direction; and

timing phases of the driving voltages applied to the movable mirror driving parts of the 5 optical scanning modules coincide substantially.

10 59. The optical scanning device as claimed in claim 51, further comprising a pair of buffer parts alternating in temporarily storing the image data so that each of the buffer parts stores image data for every other scanning line,

15 wherein the light beam emitted from said light-emission source is deflected by said movable mirror so as to scan the scanned region in the first and second opposite directions; and

the image data is read out alternately from 20 the paired buffer parts in first and second respective orders reverse to each other based on timing of the driving voltages applied to said movable mirror driving part.

25

10084485.022802

60. An optical scanning device comprising:
a plurality of optical scanning modules
arranged so that primary scanning directions thereof
coincide with each other,
5 the optical scanning modules each
comprising:
a light-emission source emitting a
light beam;
a movable mirror reflecting the light
10 beam; and
a movable mirror driving part that
causes said movable mirror to oscillate in first and
second opposite directions,
wherein a frequency causing said light-
15 emission source to emit light based on pixel
information varies in accordance with a primary
scanning position.

20

61. The optical scanning device as claimed
in claim 60, wherein said light-emission source is
modulated in accordance with image data;
25 said movable mirror is supported by torsion

10084485.022802

bars provided to a support substrate so as to be oscillatable about the torsion bars as a rotary shaft; and

5 said movable mirror driving part causes said movable mirror to oscillate by periodically generating attraction or a repulsive force between said support substrate and said movable mirror by switching voltages applied to said movable mirror driving part, said movable mirror driving part being
10 provided on both of end parts of said movable mirror, the end parts being positioned on opposite sides of each of the torsion bars.

15

62. The optical scanning device as claimed in claim 61, wherein the light beam emitted from said light-emission source of each of said optical
20 scanning modules is caused to scan a region in the primary scanning direction by said movable mirror so that image recording is performed by connecting the regions scanned by the light beams of said optical scanning modules.

25

10034485.022802

63. The optical scanning device as claimed
in claim 62, further comprising a variable pixel
frequency setting part that varies the pixel
frequency modulating said light-emission source in
5 accordance with an amount of oscillation of said
movable mirror.

10

64. The optical scanning device as claimed
in claim 63, further comprising beam detection parts
each detecting a position of the light beam deflected
by said movable mirror, the beam detection parts
15 being provided outside the scanned region at
positions corresponding to scanning starting and
termination ends of each of the optical scanning
modules, respectively,

wherein said variable pixel frequency
20 setting part varies the pixel frequency based on a
scanning period between detections of the light beam
by the beam detection parts.

25

10084485.022802

65. The optical scanning device as claimed in claim 63, wherein said variable pixel frequency setting part varies the pixel frequency in a plurality of steps during one scan.

5

66. The optical scanning device as claimed in claim 63, further comprising a variable driving current setting part that varies, in accordance with the pixel frequency, a driving current supplied to said light-emission source so as to vary an amount of light emitted therefrom.

15

67. The optical scanning device as claimed in claim 62, further comprising a beam detection part detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region at a position corresponding to a scanning starting end of each of the optical scanning modules,

25

10084485.022802

wherein, a reference signal for starting image writing is switched between detection signals output from the beam detection part based on timing of application of the driving voltages to said
5 movable mirror driving part.

10 68. The optical scanning device as claimed in claim 62, further comprising a beam detection part detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region of each of the
15 optical scanning modules,

wherein the light beam is turned within a region detectable by said beam detection part so as to perform scanning in the first and second opposite directions.

20

69. The optical scanning device as claimed
25 in claim 62, wherein the optical scanning modules are

10084485.022802

arranged so that the scanned regions of each adjacent two of the optical scanning modules are apart from each other by one scanning pitch in a secondary scanning direction; and

5 timing phases of the driving voltages applied to the movable mirror driving parts of the optical scanning modules coincide substantially.

10

70. The optical scanning device as claimed in claim 62, further comprising a pair of buffer parts alternating in temporarily storing the image data so that each of the buffer parts stores image data for every other scanning line,

15 wherein the light beam emitted from said light-emission source is deflected by said movable mirror so as to scan the scanned region in the first and second opposite directions; and

20 the image data is read out alternately from the paired buffer parts in first and second respective orders reverse to each other based on timing of the driving voltages applied to said movable mirror driving part.

10084485.022802

71. An optical scanning device comprising:
a plurality of optical scanning modules
arranged so that primary scanning directions thereof
coincide with each other,
5 the optical scanning modules each
comprising:

a light-emission source emitting a
light beam;
a movable mirror reflecting the light
10 beam; and
a movable mirror driving part that
causes said movable mirror to oscillate in first and
second opposite directions; and
a variable pixel frequency setting part
15 varying, in accordance with an amplitude of said
movable mirror, a frequency causing said light-
emission source to emit light based on pixel
information.

20

72. The optical scanning device as claimed
in claim 71, wherein said light-emission source is
25 modulated in accordance with image data;

10084485.022802

said movable mirror is supported by torsion bars provided to a support substrate so as to be oscillatable about the torsion bars as a rotary shaft; and

5 said movable mirror driving part causes said movable mirror to oscillate by periodically generating attraction or a repulsive force between said support substrate and said movable mirror by switching voltages applied to said movable mirror
10 driving part, said movable mirror driving part being provided on both of end parts of said movable mirror, the end parts being positioned on opposite sides of each of the torsion bars.

15

73. The optical scanning device as claimed in claim 72, wherein the light beam emitted from said
20 light-emission source of each of said optical scanning modules is caused to scan a region in the primary scanning direction by said movable mirror so that image recording is performed by connecting the regions scanned by the light beams of said scanning
25 modules.

10084485.022802

74. The optical scanning device as claimed
in claim 73, further comprising beam detection parts
each detecting a position of the light beam deflected
by said movable mirror, the beam detection parts
5 being provided outside the scanned region at
positions corresponding to scanning starting and
termination ends of each of the optical scanning
modules, respectively,

wherein said variable pixel frequency
10 setting part varies the pixel frequency based on a
scanning period between detections of the light beam
by the beam detection parts.

15

75. The optical scanning device as claimed
in claim 73, wherein said variable pixel frequency
setting part varies the pixel frequency in a
20 plurality of steps during one scan.

25

76. The optical scanning device as claimed

10084485.022802

in claim 73, further comprising a variable driving
current setting part that varies, in accordance with
the pixel frequency, a driving current supplied to
said light-emission source so as to vary an amount of
5 light emitted therefrom.

10 77. The optical scanning device as claimed
in claim 73, further comprising a beam detection part
detecting a position of the light beam deflected by
said movable mirror, the beam detection part being
provided outside the scanned region at a position
15 corresponding to a scanning starting end of each of
the optical scanning modules,

wherein, a reference signal for starting
image writing is switched between detection signals
output from the beam detection part based on timing
20 of application of the driving voltages to said
movable mirror driving part.

25

10084485.022802

78. The optical scanning device as claimed
in claim 73, further comprising a beam detection part
detecting a position of the light beam deflected by
said movable mirror, the beam detection part being
5 provided outside the scanned region of each of the
optical scanning modules,

wherein the light beam is turned within a
region detectable by said beam detection part so as
to perform scanning in the first and second opposite
10 directions.

79. The optical scanning device as claimed
in claim 73, wherein the optical scanning modules are
arranged so that the scanned regions of each adjacent
two of the optical scanning modules are apart from
each other by one scanning pitch in a secondary
20 scanning direction; and

timing phases of the driving voltages
applied to the movable mirror driving parts of the
optical scanning modules coincide substantially.

80. The optical scanning device as claimed
in claim 73, further comprising a pair of buffer
parts alternating in temporarily storing the image
data so that each of the buffer parts stores image
5 data for every other scanning line,

wherein the light beam emitted from said
light-emission source is deflected by said movable
mirror so as to scan the scanned region in the first
and second opposite directions; and

10 the image data is read out alternately from
the paired buffer parts in first and second
respective orders reverse to each other based on
timing of the driving voltages applied to said
movable mirror driving part.

15

81. An optical scanning device comprising:
20 a plurality of optical scanning modules
arranged so that primary scanning directions thereof
coincide with each other,

the optical scanning modules each
comprising:

25

a light-emission source emitting a

10084485.022802

light beam;

a movable mirror reflecting the light
beam; and

a movable mirror driving part that
5 causes said movable mirror to oscillate in first and
second opposite directions,

wherein a light emission period forming one
pixel on a scanned surface is varied with respect to
a primary scanning direction to be minimized in a
10 vicinity of a center of an image so that a light-
emission interval between each of pixels forming
pixel information is minimized in the vicinity of the
center of the image.

15

82. The optical scanning device as claimed
in claim 81, wherein said light-emission source is
20 modulated in accordance with image data;

said movable mirror is supported by torsion
bars provided to a support substrate so as to be
oscillatable about the torsion bars as a rotary
shaft; and

25 said movable mirror driving part causes said

10084485.022802

movable mirror to oscillate by periodically
generating attraction or a repulsive force between
said support substrate and said movable mirror by
switching voltages applied to said movable mirror
5 driving part, said movable mirror driving part being
provided on both of end parts of said movable mirror,
the end parts being positioned on opposite sides of
each of the torsion bars.

10

83. The optical scanning device as claimed
in claim 82, wherein the light beam emitted from said
15 light-emission source of each of said optical
scanning modules is caused to scan a region in the
primary scanning direction by said movable mirror so
that image recording is performed by connecting the
regions scanned by the light beams of said optical
20 scanning modules.

25

84. The optical scanning device as claimed

10084485.022802

in claim 83, further comprising a variable pixel
frequency setting part that varies the pixel
frequency modulating said light-emission source in
accordance with an amount of oscillation of said
5 movable mirror.

10 85. The optical scanning device as claimed
in claim 84, further comprising beam detection parts
each detecting a position of the light beam deflected
by said movable mirror, the beam detection parts
being provided outside the scanned region at
15 positions corresponding to scanning starting and
termination ends of each of the optical scanning
modules, respectively,

wherein said variable pixel frequency
setting part varies the pixel frequency based on a
20 scanning period between detections of the light beam
by the beam detection parts.

86. The optical scanning device as claimed in claim 84, wherein said variable pixel frequency setting part varies the pixel frequency in a plurality of steps during one scan.

5

87. The optical scanning device as claimed in claim 84, further comprising a variable driving current setting part that varies, in accordance with the pixel frequency, a driving current supplied to said light-emission source so as to vary an amount of light emitted therefrom.

15

88. The optical scanning device as claimed in claim 83, further comprising a beam detection part detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region at a position corresponding to a scanning starting end of each of the optical scanning modules,

25

10084485.022802

wherein, a reference signal for starting image writing is switched between detection signals output from the beam detection part based on timing of application of the driving voltages to said
5 movable mirror driving part.

10 89. The optical scanning device as claimed in claim 83, further comprising a beam detection part detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region of each of the
15 optical scanning modules,

wherein the light beam is turned within a region detectable by said beam detection part so as to perform scanning in the first and second opposite directions.
20

90. The optical scanning device as claimed
25 in claim 83, wherein the optical scanning modules are

10084485.022802

arranged so that the scanned regions of each adjacent two of the optical scanning modules are apart from each other by one scanning pitch in a secondary scanning direction; and

- 5 timing phases of the driving voltages applied to the movable mirror driving parts of the optical scanning modules coincide substantially.

10

91. The optical scanning device as claimed in claim 83, further comprising a pair of buffer parts alternating in temporarily storing the image data so that each of the buffer parts stores image data for every other scanning line,
- 15

- wherein the light beam emitted from said light-emission source is deflected by said movable mirror so as to scan the scanned region in the first and second opposite directions; and
- 20

- the image data is read out alternately from the paired buffer parts in first and second respective orders reverse to each other based on timing of the driving voltages applied to said movable mirror driving part.
- 25

200220158448001

92. An imaging apparatus comprising:
an optical scanning device,
the optical scanning device comprising:

a plurality of optical scanning modules
5 arranged so that primary scanning directions thereof
coincide with each other,
the optical scanning modules each
comprising:

a light-emission source emitting a
10 light beam;
a movable mirror reflecting the
light beam; and

a movable mirror driving part that
causes said movable mirror to oscillate in first and
15 second opposite directions,

wherein a frequency of pixel information
supplied to said light-emission source varies in
accordance with a primary scanning position of each
of pixels; and

20 an electrostatic image is formed on an image
holding body by dividing an image region thereon in
the primary scanning direction of each of said
optical scanning modules and is made visible by toner
to be transferred onto an output sheet of paper.

93. The imaging apparatus as claimed in claim 92, wherein image recording is performed by dividing image data of one line into a number of the optical scanning modules with respect to an image formation part performing a monochrome image formation.

10

94. The imaging apparatus as claimed in claim 92, wherein said optical scanning device is provided to each of imaging parts of different colors forming a full-color image; and
15 image recording is performed individually based on image data corresponding to each of the colors.

20

95. The imaging apparatus as claimed in claim 92, wherein said optical scanning device is provided to be shared by imaging parts of different
25 colors forming a full-color image; and

10084485.022802

image recording is performed in time series based on image data corresponding to each of the colors.

5

96. The imaging apparatus as claimed in claim 92, wherein the optical scanning device is provided for one or more of colors of respective imaging parts; and

image recording is performed in time series based on image data corresponding each of the colors.

15

97. An imaging apparatus comprising:
an optical scanning device,
the optical scanning device comprising:

a plurality of optical scanning modules arranged so that primary scanning directions thereof coincide with each other,

the optical scanning modules each comprising:

25

10084485-022802

a light-emission source emitting a
light beam;

a movable mirror reflecting the
light beam; and

5 a movable mirror driving part that
causes said movable mirror to oscillate in first and
second opposite directions,

wherein a frequency causing said light-
emission source to emit light based on pixel
10 information varies in accordance with a primary
scanning position; and

an electrostatic image is formed on an image
holding body by dividing an image region thereon in
the primary scanning direction of each of said
15 optical scanning modules and is made visible by toner
to be transferred onto an output sheet of paper.

20

98. The imaging apparatus as claimed in
claim 97, wherein image recording is performed by
dividing image data of one line into a number of the
optical scanning modules with respect to an image
25 formation part performing a monochrome image

10084485, 022802

formation.

5

99. The imaging apparatus as claimed in claim 97, wherein said optical scanning device is provided to each of imaging parts of different colors forming a full-color image; and

10 image recording is performed individually based on image data corresponding to each of the colors.

15

100. The imaging apparatus as claimed in claim 97, wherein said optical scanning device is provided to be shared by imaging parts of different colors forming a full-color image; and

20 image recording is performed in time series based on image data corresponding to each of the colors.

25

10084455 022802

101. The imaging apparatus as claimed in claim 97, wherein the optical scanning device is provided for one or more of colors of respective imaging parts; and

5 image recording is performed in time series based on image data corresponding each of the colors.

10

102. An imaging apparatus comprising:

an optical scanning device,

the optical scanning device comprising:

a plurality of optical scanning modules

15 arranged so that primary scanning directions thereof coincide with each other,

the optical scanning modules each

comprising:

a light-emission source emitting a

20 light beam;

a movable mirror reflecting the

light beam; and

a movable mirror driving part that

causes said movable mirror to oscillate in first and

25 second opposite directions; and

10084485.022802

a variable pixel frequency setting part
varying, in accordance with an amplitude of said
movable mirror, a frequency causing said light-
emission source to emit light based on pixel

5 information,

wherein an electrostatic image is formed on
an image holding body by dividing an image region
thereon in the primary scanning direction of each of
said optical scanning modules and is made visible by
10 toner to be transferred onto an output sheet of paper.

15 103. The imaging apparatus as claimed in
claim 102, wherein image recording is performed by
dividing image data of one line into a number of the
optical scanning modules with respect to an image
formation part performing a monochrome image
20 formation.

25 104. The imaging apparatus as claimed in

10084485.022802

claim 102, wherein said optical scanning device is provided to each of imaging parts of different colors forming a full-color image; and

image recording is performed individually
5 based on image data corresponding to each of the colors.

10

105. The imaging apparatus as claimed in claim 102, wherein said optical scanning device is provided to be shared by imaging parts of different colors forming a full-color image; and

15 image recording is performed in time series based on image data corresponding to each of the colors.

20

106. The imaging apparatus as claimed in claim 102, wherein the optical scanning device is provided for one or more of colors of respective

25 imaging parts; and

10084485.022802

image recording is performed in time series
based on image data corresponding each of the colors.

5

107. An imaging apparatus comprising:
an optical scanning device,
the optical scanning device comprising:

10 a plurality of optical scanning modules
arranged so that primary scanning directions thereof
coincide with each other,

the optical scanning modules each
comprising:

15 a light-emission source emitting a
light beam;

a movable mirror reflecting the
light beam; and

a movable mirror driving part that
20 causes said movable mirror to oscillate in first and
second opposite directions,

wherein a light emission period forming one
pixel on a scanned surface is varied with respect to
a primary scanning direction to be minimized in a
25 vicinity of a center of an image so that a light-

10084485-022802

emission interval between each of pixels forming pixel information is minimized in the vicinity of the center of the image; and

an electrostatic image is formed on an image holding body by dividing an image region thereon in the primary scanning direction of each of said optical scanning modules and is made visible by toner to be transferred onto an output sheet of paper.

10

108. The imaging apparatus as claimed in claim 107, wherein image recording is performed by dividing image data of one line into a number of the optical scanning modules with respect to an image formation part performing a monochrome image formation.

20

109. The imaging apparatus as claimed in claim 107, wherein said optical scanning device is provided to each of imaging parts of different colors

20081118.022802

forming a full-color image; and

image recording is performed individually
based on image data corresponding to each of the
colors.

5

110. The imaging apparatus as claimed in
10 claim 107, wherein said optical scanning device is
provided to be shared by imaging parts of different
colors forming a full-color image; and

image recording is performed in time series
based on image data corresponding to each of the
15 colors.

20 111. The imaging apparatus as claimed in
claim 107, wherein the optical scanning device is
provided for one or more of colors of respective
imaging parts; and

image recording is performed in time series
25 based on image data corresponding each of the colors.

10084485.022802

112. An optical scanning method employing
an optical scanning device that causes a light beam
emitted from a light-emission source to perform
scanning by deflecting the light beam by a movable
5 mirror oscillating in first and second opposite
directions in a resonant state,

wherein image writing is performed by
selecting, in accordance with a resonant frequency of
the movable mirror, a reference frequency causing the
10 light-emission source to emit light based on pixel
information.

15

113. An optical scanning method employing
an optical scanning device that causes a light beam
emitted from a light-emission source to perform
scanning by deflecting the light beam by a movable
20 mirror oscillating in first and second opposite
directions in a resonant state,

wherein image writing is performed by
supplying the light-emission source with pixel
information whose frequency is varied in accordance
25 with a primary scanning position of each of pixels.

10084485.022802

114. An optical scanning method employing an optical scanning device that causes a light beam emitted from a light-emission source to perform scanning by deflecting the light beam by a movable mirror oscillating in first and second opposite directions in a resonant state, the optical scanning method comprising the steps of:

- (a) detecting an oscillation displacement of the movable mirror;
- (b) setting a frequency variation section based on a detection signal obtained by said step (a); and
- (c) performing image writing while varying, step by step from a reference frequency in the frequency variation section, a frequency causing the light-emission source to emit light based on pixel information.

20

115. An optical scanning device comprising:
a plurality of optical scanning modules arranged so that primary scanning directions thereof coincide with each other,

25

10084485.022802

the optical scanning modules each
comprising:

a light-emission source emitting a
light beam;

5 a movable mirror reflecting the light
beam; and

a movable mirror driving part that
causes said movable mirror to oscillate in first and
second opposite directions,

10 wherein control is performed so that a
termination end of one of images formed by scanning
by the light beams of said optical scanning modules
coincides with a starting end of an adjacent one of
the images.

15

116. The optical scanning device as claimed
20 in claim 115, wherein said light-emission source is
modulated in accordance with image data;

said movable mirror is supported by torsion
bars provided to a support substrate so as to be
oscillatable about the torsion bars as a rotary
25 shaft; and

10084485-022802

said movable mirror driving part causes said movable mirror to oscillate by periodically generating attraction or a repulsive force between said support substrate and said movable mirror by switching voltages applied to said movable mirror driving part, said movable mirror driving part being provided on both of end parts of said movable mirror, the end parts being positioned on opposite sides of each of the torsion bars.

10

117. The optical scanning device as claimed in claim 116, wherein the light beam emitted from said light-emission source of each of said optical scanning modules is caused to scan a region in the primary scanning direction by said movable mirror so that image recording is performed by connecting the regions scanned by the light beams of said optical scanning modules.

25

10084485.022802

118. The optical scanning device as claimed
in claim 117, further comprising a variable pixel
frequency setting part that varies a pixel frequency
modulating said light-emission source in accordance
5 with an amount of oscillation of said movable mirror.

10 119. The optical scanning device as claimed
in claim 118, further comprising beam detection parts
each detecting a position of the light beam deflected
by said movable mirror, the beam detection parts
being provided outside the scanned region at
15 positions corresponding to scanning starting and
termination ends of each of the optical scanning
modules, respectively,

wherein said variable pixel frequency
setting part varies the pixel frequency based on a
20 scanning period between detections of the light beam
by the beam detection parts.

120. The optical scanning device as claimed in claim 118, wherein said variable pixel frequency setting part varies the pixel frequency in a plurality of steps during one scan.

5

121. The optical scanning device as claimed
10 in claim 118, further comprising a variable driving current setting part that varies, in accordance with the pixel frequency, a driving current supplied to said light-emission source so as to vary an amount of light emitted therefrom.

15

122. The optical scanning device as claimed
20 in claim 117, further comprising a beam detection part detecting a position of the light beam deflected by said movable mirror, the beam detection part being provided outside the scanned region at a position corresponding to a scanning starting end of each of
25 the optical scanning modules,

10084485.022802

wherein, a reference signal for starting
image writing is switched between detection signals
output from the beam detection part based on timing
of application of the driving voltages to said
5 movable mirror driving part.

10 123. The optical scanning device as claimed
in claim 117, further comprising a beam detection
part detecting a position of the light beam deflected
by said movable mirror, the beam detection part being
provided outside the scanned region of each of the
15 optical scanning modules,

wherein the light beam is turned within a
region detectable by said beam detection part so as
to perform scanning in the first and second opposite
directions.
20

124. The optical scanning device as claimed
25 in claim 117, wherein the optical scanning modules

10084435-022802

are arranged so that the scanned regions of each adjacent two of the optical scanning modules are apart from each other by one scanning pitch in a secondary scanning direction; and

5 timing phases of the driving voltages applied to the movable mirror driving parts of the optical scanning modules coincide substantially.

10

125. The optical scanning device as claimed in claim 117, further comprising a pair of buffer parts alternating in temporarily storing the image data so that each of the buffer parts stores image data for every other scanning line,

15 wherein the light beam emitted from said light-emission source is deflected by said movable mirror so as to scan the scanned region in the first and second opposite directions; and

20 the image data is read out alternately from the paired buffer parts in first and second respective orders reverse to each other based on timing of the driving voltages applied to said
25 movable mirror driving part.

10084485.022802

126. An imaging apparatus comprising:

an optical scanning device,

the optical scanning device comprising:

a plurality of optical scanning modules

5 arranged so that primary scanning directions thereof
coincide with each other,

the optical scanning modules each
comprising:

a light-emission source emitting a

10 light beam;

a movable mirror reflecting the

light beam; and

a movable mirror driving part that
causes said movable mirror to oscillate in first and
15 second opposite directions,

wherein control is performed so that a
termination end of one of images formed by scanning
by the light beams of said optical scanning modules
coincides with a starting end of an adjacent one of
20 the images; and

an electrostatic image is formed on an image
holding body by dividing an image region thereon in
the primary scanning direction of each of said
optical scanning modules and is made visible by toner
25 to be transferred onto an output sheet of paper.

10084485.022802

127. The imaging apparatus as claimed in
claim 126, wherein image recording is performed by
dividing image data of one line into a number of the
optical scanning modules with respect to an image
5 formation part performing a monochrome image
formation.

10

128. The imaging apparatus as claimed in
claim 126, wherein said optical scanning device is
provided to each of imaging parts of different colors
forming a full-color image; and

15

image recording is performed individually
based on image data corresponding to each of the
colors.

20

129. The imaging apparatus as claimed in
claim 126, wherein said optical scanning device is
provided to be shared by imaging parts of different
25 colors forming a full-color image; and

10084485.022802

image recording is performed in time series based on image data corresponding to each of the colors.

5

130. The imaging apparatus as claimed in claim 126, wherein the optical scanning device is provided for one or more of colors of respective imaging parts; and

image recording is performed in time series based on image data corresponding each of the colors.

15

10084485.022802